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being to the north of them is a sufficient reason why the wind does not change to south of west. The polar-wind gales which are experienced in these high latitudes, seem to derive their air from that upper current returning from the pole, part of which sometimes makes its downward way to the surface in high latitudes, especially in spring.

The gales of the southern hemisphere, just remarked upon, have their exact counterpart in the high latitudes of the northern hemisphere, though I have not noticed them to be so constant, perhaps on account of there being much more land in the northern hemisphere. Still all seamen know how, after getting north of the N.E. trades, we look for the wind to come from S., S.W., and W., with warm air and rain.

These curves, and the arguments deduced from them, seem to favour Maury's theory of the circulation of the air; where he supposes two rising currents we have a low barometer, and where he supposes two descending currents we find a high barometer; but they are also suggestive, and a series made with standard instruments for each month in the year might lead to most useful discoveries as to the normal circulation, and its disturbance by the effect of land. How strikingly these curves prove the uniform state of the atmosphere in those parts of the Atlantic between the trades, at the same seasons of the year! especially in contrast with their sudden distortions on the polar side of the trades, where their irregularities resemble the waves of the sea in the same latitudes, which may in fact be called the resultants of these distortions. Similar curves, outward and homeward, deduced from the same logs, between the latitudes of 40° South to 20° North, in the Indian Ocean and Bay of Bengal, would, I think, give interesting results, and I hope some day to work at them.

A track-chart accompanies these remarks, showing the routes inside and outside the Cape Verde Islands, together with a homeward-bound route, thus showing the longitude in which each degree of latitude has been crossed.

X. "On the Sextactic Points of a Plane Curve." By William Spottiswoode, M.A., F.R.S., &c. Received June 15, 1865.

(Abstract.)

The beautiful result given by Professor Cayley in the Proceedings of the Royal Society (vol. xiii. p. 553), and deduced, as I understand, by the methods of his memoir "On the Conic of Five-pointic Contact" (Philosophical Transactions, vol. cxlix. p. 371), led me to inquire how far the formulæ of my own memoir "On the Contact of Plane Curves" (Philosophical Transactions, vol. clii. p. 41) were applicable to the solution of the present problem.

The formulæ in question are as follows: if $U=0$ be the equation of the curve, H its Hessian, and $V=(a, b, c, f, g, h \between x, y, z)^2=0$ that of the conic of five-pointic contact; and if, moreover, α, β, γ being arbitrary constants,

$$\delta = \alpha x + \beta y + \gamma z$$

$$\Box = (v\gamma - w\beta)\,\partial_x + (w\alpha - u\gamma)\,\partial_y + (u\beta - v\alpha)\,\partial_z,$$

then, writing as usual

$$\partial_x U = u,\ \ \partial_y U = v,\ \ \partial_z U = w,\ \ \partial_x H = p,\ \ \partial_y H = q,\ \ \partial_z H = r,$$

$$\partial^2 U = u_1, \ldots \partial_y \partial_z U = u', \ldots$$

$$A = v_1 w_1 - u'^2, \ldots F = v' w' - u_1 u', \ldots$$

the values of the ratios $a : b : c : f : g : h$ are determined by the equations

$$V = 0,\ \Box V = 0, \ldots \Box^4 V = 0.$$

Now, if at the point in question the curvature of U be such that a sixth consecutive point lies on the conic V, the point is called a sextactic point; and the condition for this will be, in terms of the above formulæ, $\Box^5 V = 0$. From the six equations $V = 0$, $\Box V = 0, \ldots \Box^5 V = 0$, the quantities $a, b, \ldots h$ can be linearly eliminated, and the result will be an equation which, when combined with $U = 0$, will determine the ratios of $x : y : z$, the coordinates of the sextactic points of U. But the equation so derived contains (beside other extraneous factors) the indeterminate quantities α, β, γ, to the degree 15, which remain to be eliminated. Instead, however, of proceeding as above, I eliminate α, β, γ beforehand, in such a way that $V = 0$, $\Box V = 0$, $\Box^2 V = 0$ take the form

$$\frac{\partial_x V}{u} = \frac{\partial_y V}{v} = \frac{\partial_z V}{w} = \frac{\Delta V}{\varpi H};$$

and more generally if $W = 0$, representing any one of the series $V = 0$, $\Box V = 0, \ldots$ from which α, β, γ have been already eliminated, the equations $W = 0$, $\Box W = 0$, $\Box^2 W = 0$ are replaced by

$$\frac{\partial_x W}{u} = \frac{\partial_y W}{v} = \frac{\partial_z W}{w} = \frac{\Delta W}{\varpi H},$$

where H is the Hessian of U, ϖ a numerical factor, and

$$\Delta = (A, B, C, F, G, H)(\partial_x, \partial_y, \partial_z)^2.$$

Proceeding in this way, I obtain a result free from α, β, γ in the three forms,

$$\begin{vmatrix} \partial_x(uX - xP) & \partial_x(uY - yP) & \partial_x(uZ - zP)\,u \\ \partial_y(uX - xP) & \partial_y(uY - yP) & \partial_y(uZ - zP)\,v \\ \partial_z(uX - xP) & \partial_z(uY - yP) & \partial_z(uZ - zP)\,w \\ \Delta\,(uX - xP) & \Delta\,(uY - yP) & \Delta\,(uZ - zP)\,\varpi_2 H \end{vmatrix} = 0,$$

$$\begin{vmatrix} \partial_x(vX - xQ) & \partial_x(vY - yQ) & \partial_x(vZ - zQ)\ u \\ \vdots & \vdots & \vdots\ \ \vdots \end{vmatrix} = 0,$$

$$\begin{vmatrix} \partial_x(wX - xR) & \partial_x(wY - yR) & \partial_x(wZ - zR)\ u \\ \vdots & \vdots & \vdots\ \ \vdots \end{vmatrix} = 0,$$

where

$$X=vr-wq,\ Y=wp-ur,\ Z=uq-vp,$$
$$P=u_1\,X+w'\,Y+v'Z,$$
$$Q=w'\,X+v_1Y+u'Z$$
$$R=v'\,X+u'\,Y+w_1\,Z,$$

and ϖ_2 is a numerical factor.

Each of these equations is of the degree $18u-36$ in the variables; but it is shown in the paper that they are all divisible by H, and that they further differ only in respect of the several factors u^3, v^3, w^3. Dividing these out, the degree of the result is reduced to

$$(18n-36)-3\,(n-2)-3\,(n-1)=12n-27,$$

as it should be. I have not thought it necessary to reduce the expressions completely, as the form of the result given by Professor Cayley leaves nothing to be desired, and the point specially considered here is the degree of the equation. At the same time, the reductions necessarily effected in the course of the proof of the extraneous factors are sufficient to indicate that the formulæ of the present memoir would lead to an equation of the same form as that given by Professor Cayley.

XI. "Products of the Destructive Distillation of the Sulphobenzolates. No. I." By JOHN STENHOUSE, LL.D., F.R.S., &c. Received June 14, 1865.

Preparation of Sulphobenzolic Acid. Purification of the Benzol.

As most specimens of benzol met with in commerce, even when rectified, contain impurities besides toluol and the other homologues of benzol, I have generally found it necessary to submit it to purification before using it for the preparation of sulphobenzolic acid. The commercial article boiling between 80° and 90° C., was mixed with about one-twentieth of its bulk of concentrated sulphuric acid, and digested for eight or ten hours in a flask furnished with a long condensing-tube. By this means a considerable amount of the impurities contained in the crude benzol were converted by the acid into a black gelatinous mass similar in appearance to that obtained in the preparation of olefiant gas, a large quantity of sulphurous acid gas was given off, and the impure benzol acquired a reddish-brown or dark purple colour. It was separated from the black mass, washed with a small quantity of water, and again heated once or twice with concentrated acid, but for a shorter time than at first, until fresh acid when heated with it ceased to become dark-coloured. In this operation the benzol loses from 10 to 20 per cent., according to the amount of impurity present, and small quantities of sulphobenzolic acid are produced.

Conversion of Benzol into crude Sulphobenzolic Acid.

This acid may be prepared by the process given by Mitscherlich, which consists in adding benzol to fuming oil of vitriol contained in a flask, as long as it dissolves, with agitation and frequent cooling. Notwithstanding